

**The form of organic matter in the muddy sediments
near Eckernfoerde Bay, Germany**

by

Yoko Furukawa

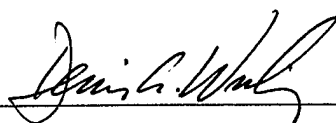
Center for Marine Sciences
The University of Southern Mississippi
Stennis Space Center, MS 39529

Quarterly Technical Report

Submitted to

Naval Research Laboratory (NRL-SSC)
Code 7431
Stennis Space Center, MS 39529-5004

Grant No. N00014-95-1-G907

Approved: 

Denis Wiesenburg, Principal Investigator

Technical Report No. CMS-96-01

March 31, 1996

Approved for public release; distribution is unlimited

19960618 000

DTIC QUALITY INSPECTED 1

1. Introduction

Organic matter (OM) is one of the most important components in the seafloor sediments in Eckernförde Bay, Germany. The OM accounts for up to 10 weight % of sediments in some parts of the Bay. Because OM is relatively low in density and often hydrophilic, its role in defining the sediment structure and microfabric can be significant. Therefore, it is important to understand the form of OM in the sediments.

This study was originated under the hypothesis that the OM is either incorporated into the fecal pellets which are abundant in the study area sediments, or coating the surface of sediment particles. The clay-sized particles would provide the most surface area for the OM coating due to their large specific surface area.

In order to test the above hypothesis, the relationships among OM contents, fecal pellet contents, and clay contents were examined.

2. Methods

The sediment samples were obtained during the Coastal Benthic Boundary Special Research Program (CBBL-SRP) Eckernförde Campaign using box and gravity cores. The sediment microfabric samples were obtained and prepared using the method detailed in Lavoie et al. (1996). Some of the sediment samples were kept frozen until the time of total organic carbon (TOC) analysis. The OM contents were represented by the TOC values. TOC was analyzed using Rock-Eval method at Humble Geochemistry, Humble, Texas. The sediment samples were analyzed for various index properties including the grain size using the Folk method (Folk, 1974) at the Naval Research Laboratory by Dr. Dawn Lavoie.

After embedded in epoxy, the microfabric samples were polished, carbon coated, and observed under a scanning electron microscope (SEM). Triplicate SEM photographs were taken at the magnification of approximately $\times 100$ for each sample, and were digitized for the subsequent image analysis. Each photograph was visually examined for fecal pellets. The pellets were then painted and the ratio of the numbers of painted pixels to total pixels was determined using Image Tool, an image analysis program.

3. Results

The TOC values of the gravity cores P1 and P3, and box cores 634, 652, 658, 662, and 663 are shown in Figure 1. The grain size distribution is shown in Table 1 (Dawn Lavoie, unpublished data).

An SEM image of P1-30 cm below sea floor (bsf) is shown in Figure 2. The pellets were painted as shown in Figure 3. The volume % of pellets estimated by the painting of pellets are shown in Figure 4 for the samples from gravity cores P1 and P3.

4. Discussion

TOC vs. Pellets

Figure 5 shows the relationship between the TOC values and pellet volume %. There is little correlation between the two variables indicating that the OM may not be preferentially incorporated into fecal pellets.

TOC vs. Clay Content

Figure 6 shows the relationship between the TOC values and clay content. There is a very strong positive correlation between the two variables. The strong correlation may be explained by the coating of OM around clay particles due to their large specific surface area. It may also be due to the faster OM oxidation in less muddy sediments where permeability is high and the electron acceptors (e.g., O_2 , SO_4^{2-}) are supplied more readily.

5. Further study

In order to determine the form of OM in sediments, more microscope work is necessary. In order to preserve OM in microfabric samples, freeze drying, rather than fluid exchanging, may be necessary as the fluid exchange may dissolve or alter OM.

Because fecal pellets are often very important components of sediment structure and microfabric as seen in Figures 2 and 3, their effect on sediment geophysical properties need to be examined.

6. References

- Folk, R. L. (1974) Petrology of Sedimentary Rock. Hamphill Publishing Company.
- Lavoie D. M., Lavoie, D. L., Pittenger, H. A. and Bennet, R. H. (1996) Bulk sediment properties interpreted in light of qualitative and quantitative microfabric analysis. GeoMarine Letters. in press.

Table 1. Grain size distribution of samples from gravity cores (P1, P2) and box cores (634, 652, 658, 662, 663). The data set is provided by Dr. Dawn Lavoie (unpublished data).

Core ID	Depth (cm)	sand (weight %)	silt (weight %)	clay (weight %)	Mean Grain Size (ϕ)
P1	30	1.39	81.53	17.06	7.35
	65	1.35	83.13	15.51	6.89
	75	0.66	78.97	20.35	7.42
	85	0.83	78.35	20.81	7.56
	98	1.02	81.48	17.48	7.52
	108	0.95	78.84	20.20	7.56
	119	1.69	76.43	21.87	7.67
	129	1.34	78.74	19.90	7.63
	143	0.87	47.40	51.71	8.39
P3	64	0.92	74.14	24.93	7.51
	75	1.53	77.00	21.45	7.22
	81	1.14	75.63	22.95	7.66
	102	0.42	77.08	22.49	7.69
	117	0.63	77.92	19.45	7.59
	128	12.01	66.24	21.74	7.34
	135	0.74	75.70	23.54	7.80
634	top	4.63	53.71	41.64	7.16
	middle	5.98	80.20	13.80	7.05
	bottom	6.96	76.33	16.69	7.16
652	top	78.14	19.41	2.44	4.08
	middle	84.88	13.45	1.66	3.65
	bottom	89.13	9.41	1.45	3.41
658	top	72.27	24.19	3.52	3.85
	middle	75.69	21.13	3.17	4.08
	bottom	79.16	18.10	2.72	3.75
662	top	21.06	65.22	13.71	6.23
	middle	43.48	52.91	3.59	4.66
	bottom	61.62	31.83	6.54	4.56
663	top	20.31	61.38	18.29	5.74
	middle	28.27	66.49	5.22	4.96
	bottom	23.55	62.03	14.40	6.01

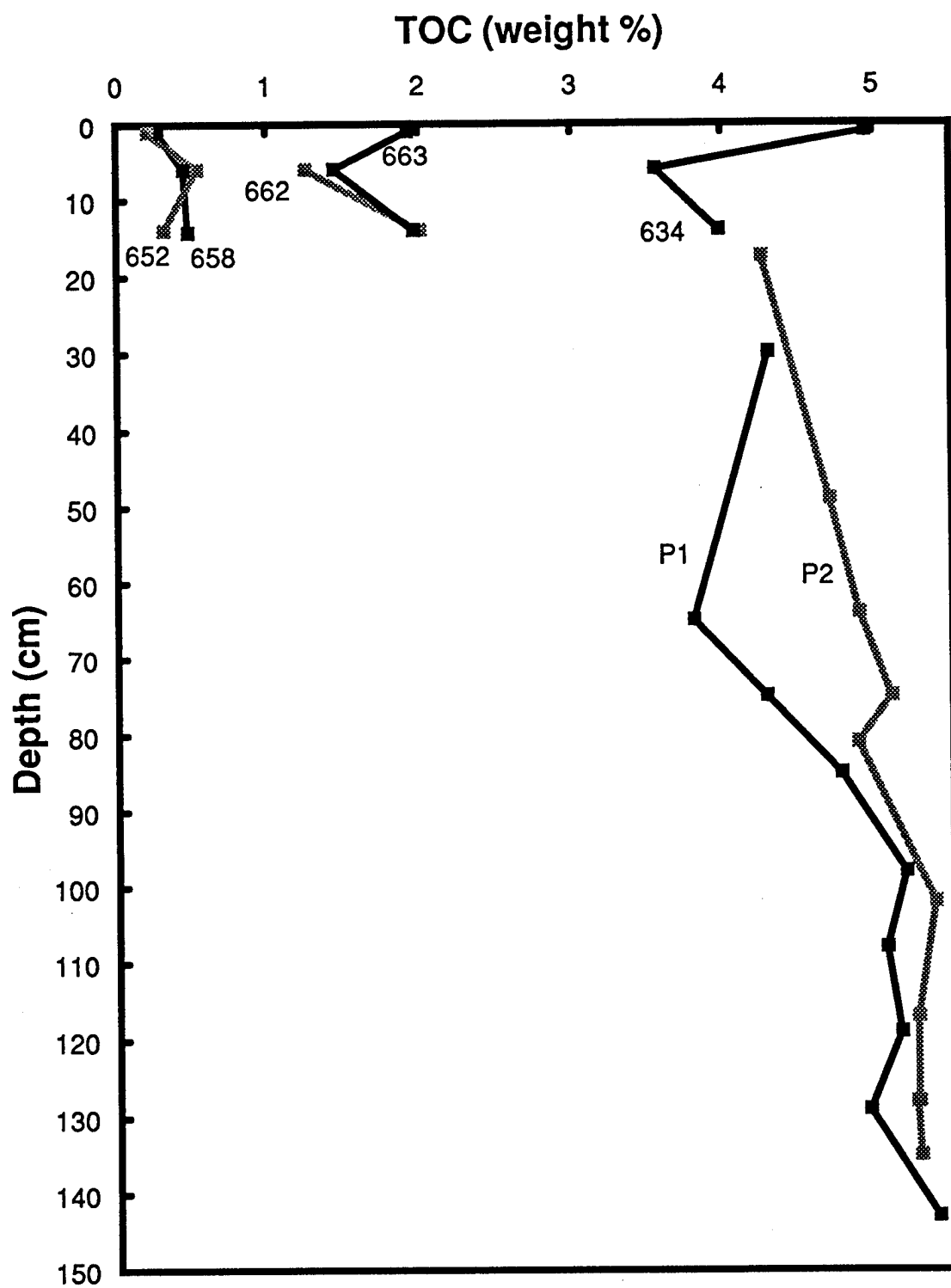
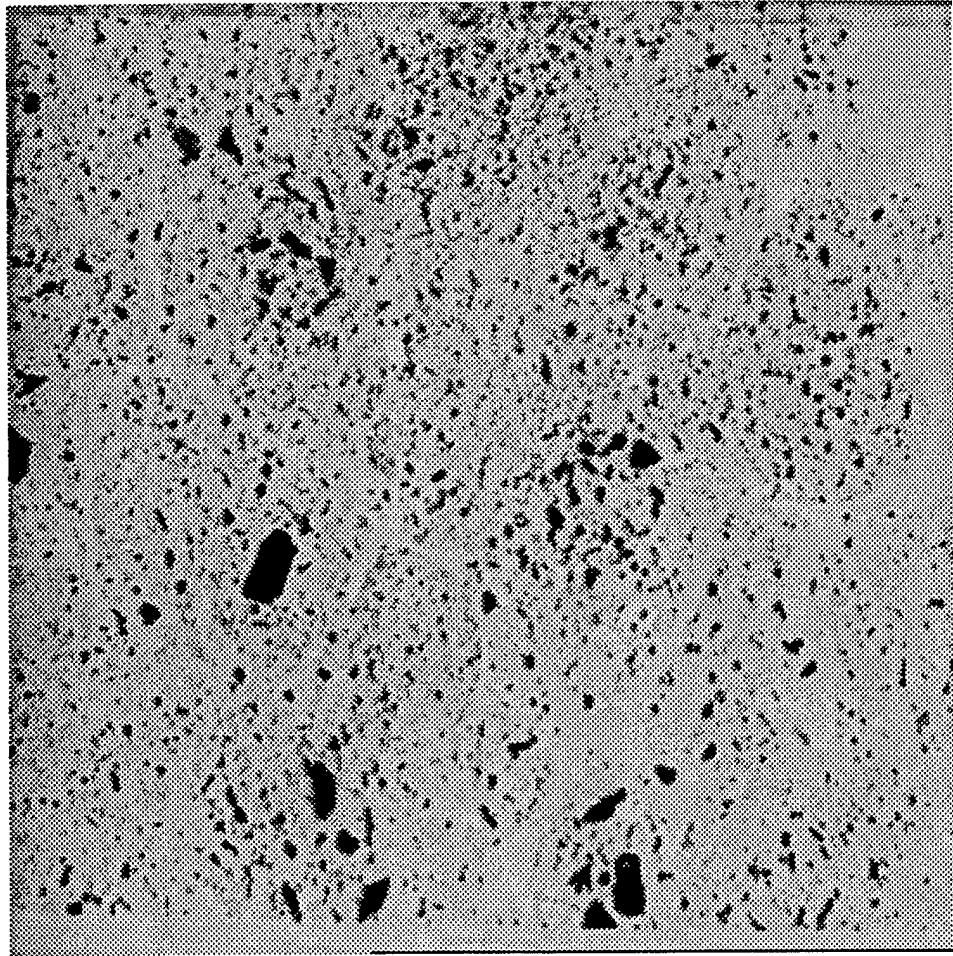
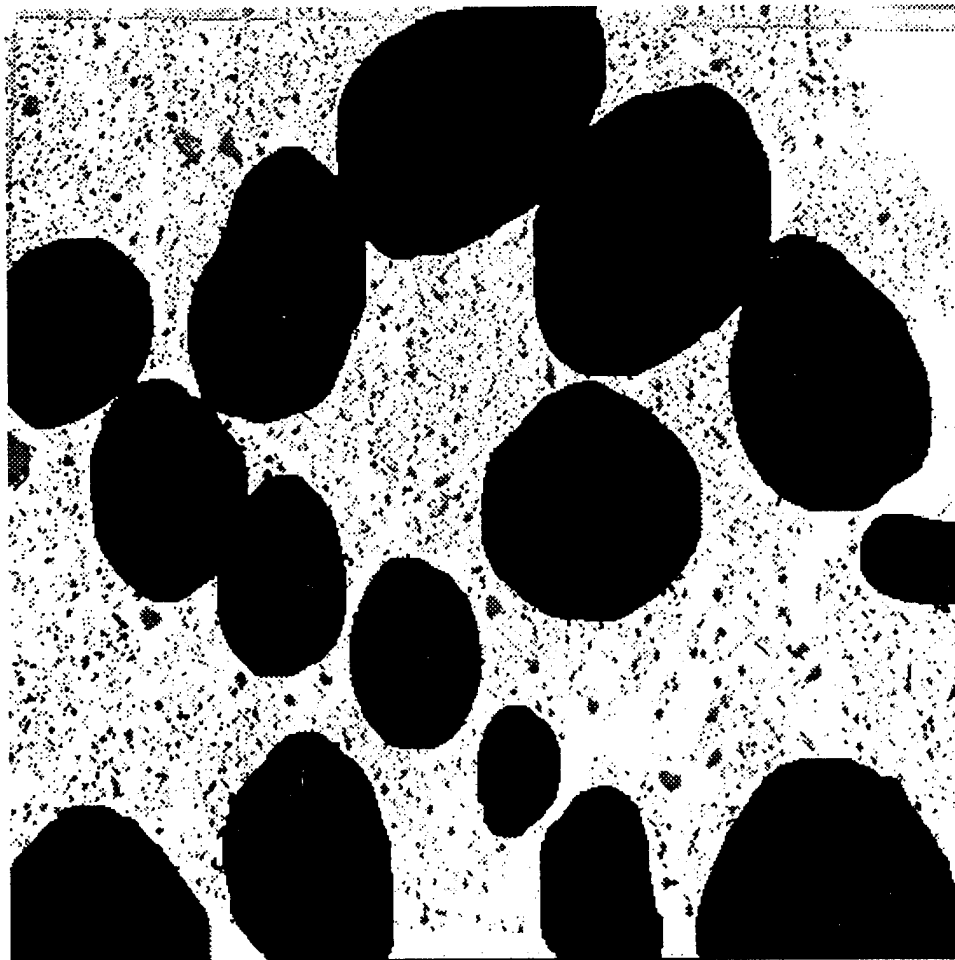


Figure 1. The depth profiles of TOC values.



100μm

Figure 2. An SEM image of a pellet-rich sediment sample (P1-30 cm bsf).



100μm

Figure 3. The same view as Figure 1 with the painted pellets.

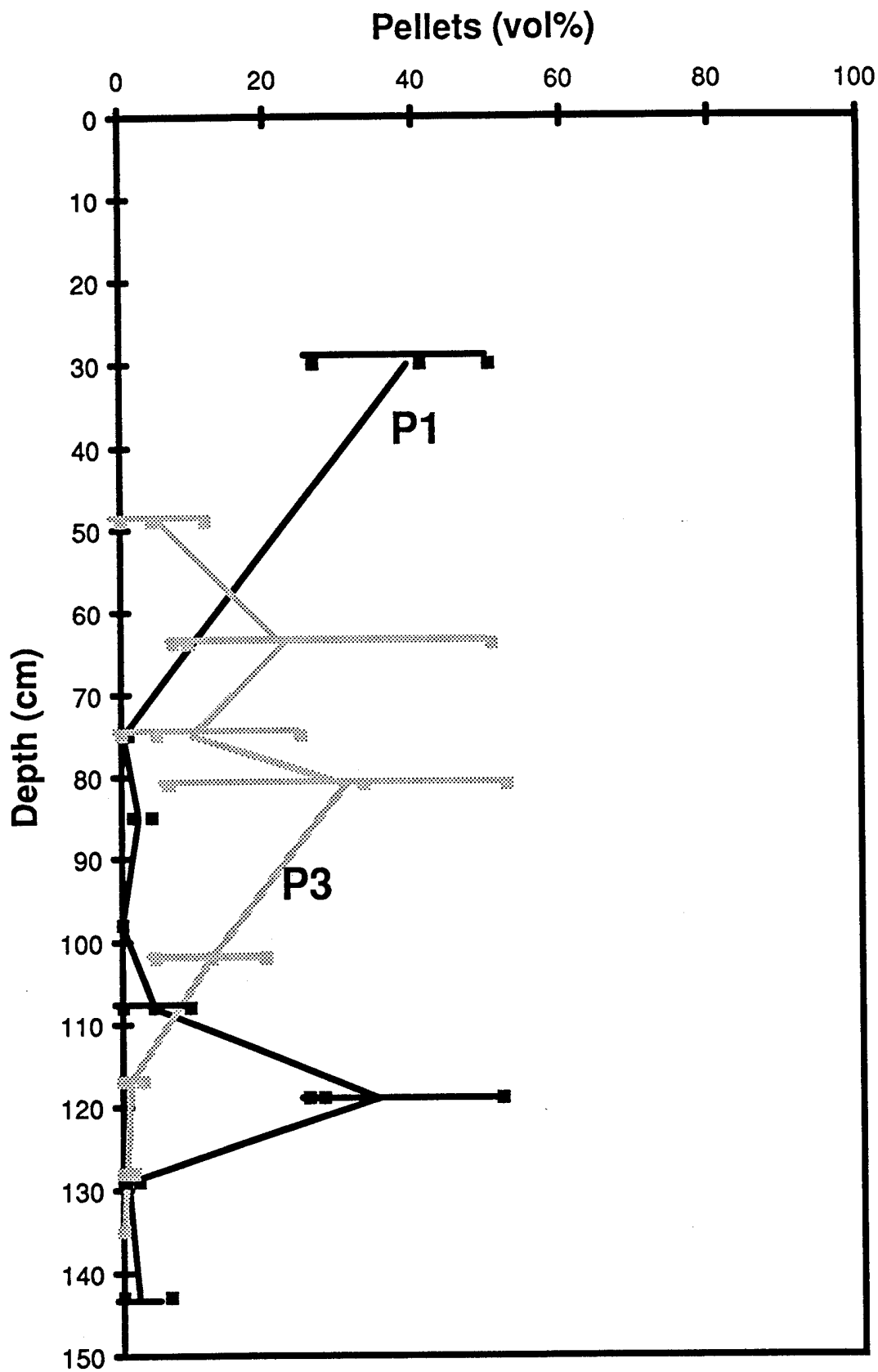


Figure 4. The depth profiles of fecal pellet contents.

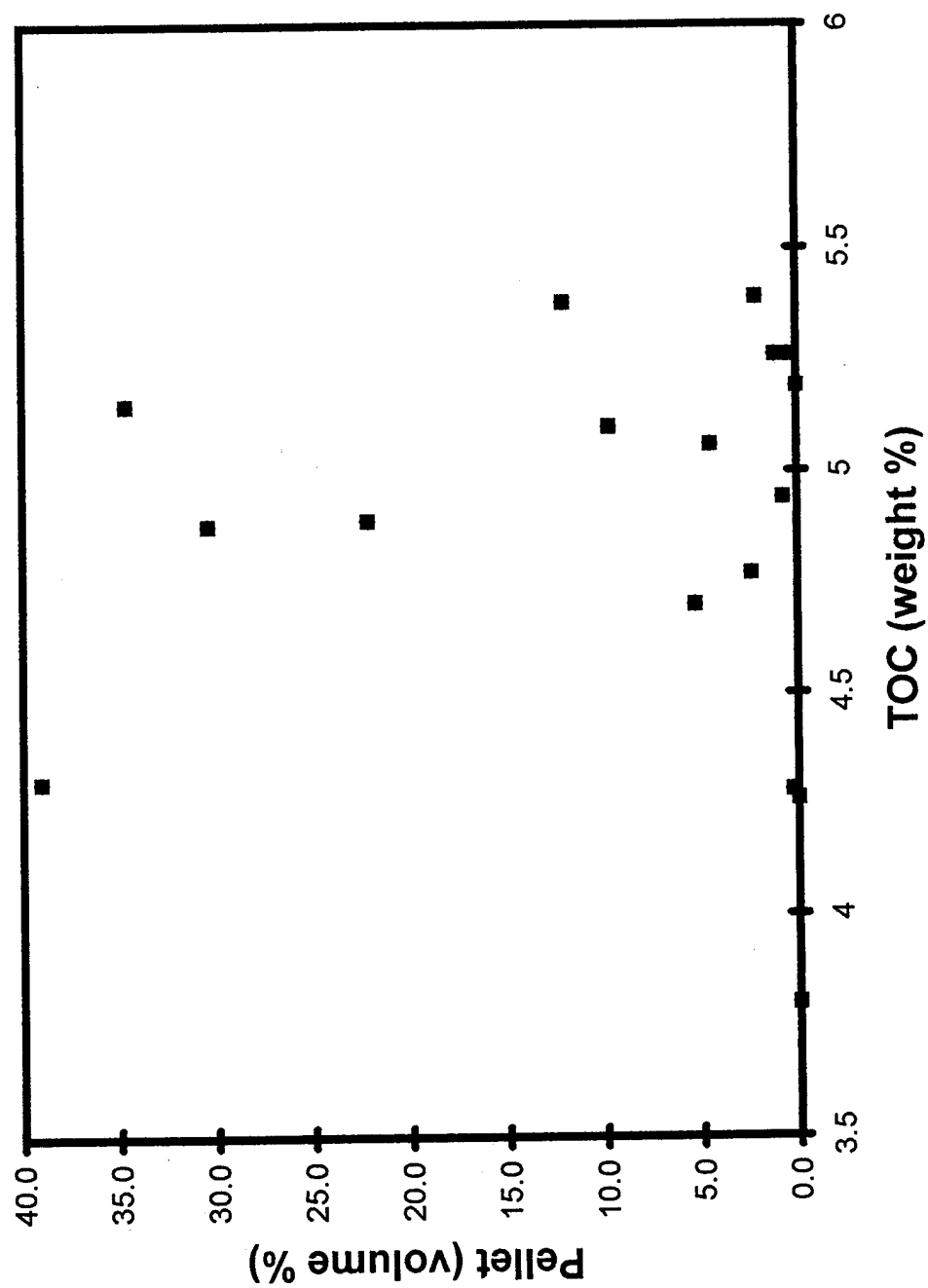


Figure 5. The relationship between the TOC values and fecal pellet content.

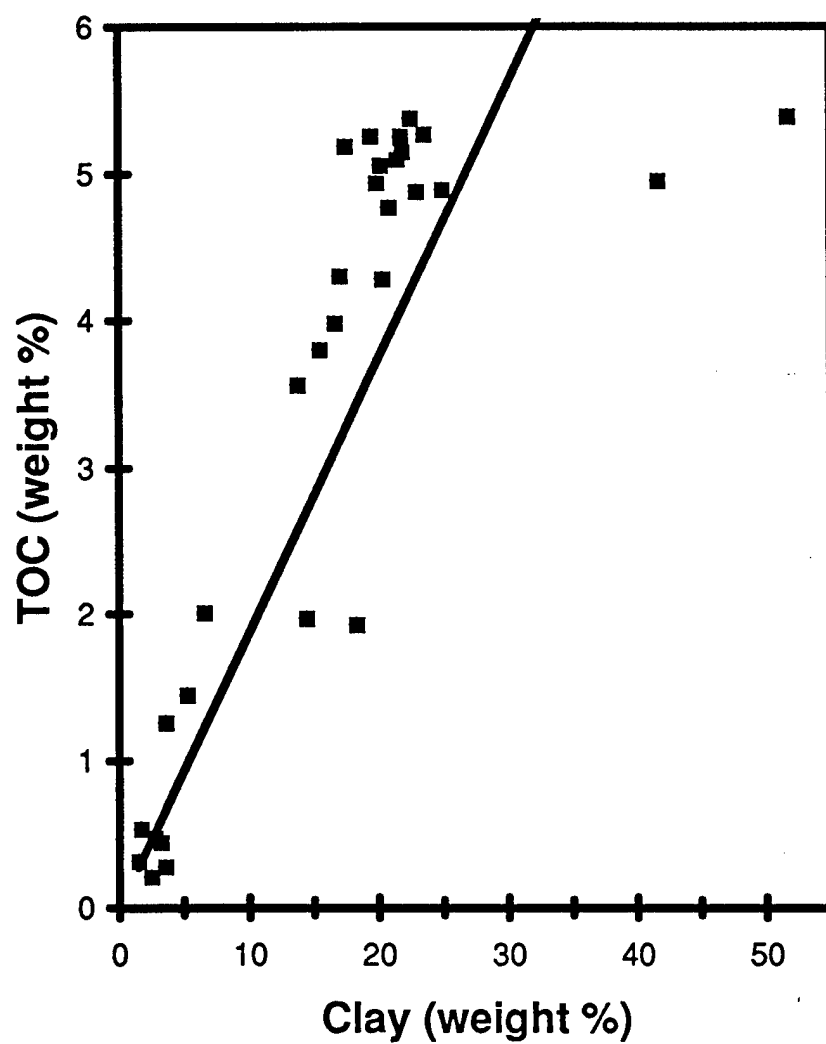


Figure 6. The relationship between the amount of clay-sized particles and total organic carbon (TOC).

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. Agency Use Only (Leave blank).		2. Report Date. March 1996		3. Report Type and Dates Covered. Technical Report 1/96-3/96
4. Title and Subtitle. The form of organic matter in the muddy sediment snear Eckernfoerde Bay, Germany			5. Funding Numbers. Program Element No. Project No. Task No. Accession No.	
6. Author(s) Yoko Furukawa				
7. Performing Organization Name(s) and Address(es). Center for Marine Sciences The University of Southern Mississippi Building 1103, Room 102 Stennis Space Center, MS 39529			8. Performing Organization Report Number CMS-96-01	
9. Sponsoring/Monitoring Agency Name(s) and Address(es). Department of The Navy Naval Research Laboratory (NRL-SSC) CODE 3250: BJO Stennis Space Center, MS 39529			10. Sponsoring/Monitoring Agency Report Number. CR/7431--96-0006	
11. Supplementary Notes. ONR Research Grant No. N00014-95-1-G907				
12a. Distribution/Availability Statement. Approved for public releases; distribution is unlimited.			12b. Distribution Code.	
13. Abstract (Maximum 200 words). The organic matter contents in the seafloor sediments from Eckernfoerde Bay, Germany, is positively correlated to the available specific surface area of the sediments. This may be attributed to the organic matter coating of sediment particles.				
14. Subject Terms. Shelf sediments, organic matter, specific surface area, fecal pellets, Eckernfoerde Bay			15. Number of Pages. 11	
			16. Price Code.	
17. Security Classification of Report Unclassified	18. Security Classification of This Page. Unclassified	19. Security Classification of Abstract. Unclassified	20. Limitation of Abstract. SAR	